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# Chaotic

## Darling Downs Soaring Club Newsletter April 2009

Hi, sorry about the delays in getting this out; I've been quite busy getting to know Brisbane's bus routes. (As I'm now working for Brisbane Council as a 'bus operator'; that's 'driver' to most people...

First an article from Jenny about wheels and minds. There are some interesting points made here, and this article should be of interest to all pilots.

### **Not Just a Wheels Up Landing.**

In January, Jeremy and I planned to fly the Victorian State Comps together at Benalla and then I would fly the Multi Class Nationals. The weather was very trying. Long hot summer days, many over 40 degrees. All blue days with no cumulus cover to provide any shade. Some days we sat on the grid for hours waiting for the temperature to break 38 degrees (or so) so the thermals would break the inversion. It was all hard work and, as is the case for many comps, it was a bit of an endurance event. Two days in particular were the most difficult days I had ever gone cross country - 25 kt winds, blue,

convection to about 4000 above ground.

Day 3 of the nationals was one of these days. So I will take you to the end of the flight ... not far from Benalla, I took a scratchy climb to about 4000 agl but it was not enough to get back to Benalla with the wind and the infamous awful air that you get coming into Benalla. But the thermal petered out and I had no choice but to keep heading to Benalla. Not long after that, I joined up with two other gliders who had also reached their tops of climb and made the same decision to keep heading towards Benalla. Mistake number 1 - having struggled around the most difficult day in all my flying on my own with my own efforts, I decided to tag onto two gliders, knowing they were much more experienced than me they would know better and perhaps I was being conservative not thinking I would make it.

We all trickled along towards Benalla. Direct track left few options, left of track there are few landing options (i.e. a lake), to the right of track you can break away and head to landable options. The two pilots were travelling direct track with me behind and slightly

lower. I felt uncomfortable and started tracking to the right to the landable area and they did the same in front of me shortly afterwards. By now it was getting pretty obvious that none of us were going to make Benalla unless we got a low climb. So the 3 of us trickled along some more, steadily heading to the right to make sure we had an out, but all the time marginally increasing the distance to go.

Then we hit lift and all took the climb with me at the bottom of the thermal. By now I was definitely flying their race, not mine. When the top pilot lead off and then the second pilot, I just took a few more turns and followed. Again, knowing these guys were eminently more experienced than me I used their decision, not mine.

So the two guys in front dribbled into Benalla and gave straight in calls. I had a little bit more height than them, which allowed me to do a short base and turn onto final. The strip we were landing on was the one with the least options of undershoot (i.e. none) so with the strong wind I allowed plenty of height over the fence for a nice steep approach.

On passing over the threshold I drew a sigh of relief having made it home after such a struggle but the relief was shortlived when I came to a grinding halt on the belly. It was lucky it was a nice slow landing into a strong wind and on the softest patch of grass I could have found. I wanted to dig a much bigger hole and bury myself in it to hide from the embarrassment.

So how could I have done such a stupid thing? 1300 hrs, 1800 successful landings and 1800 FUST checks and why did I forget it now? I've even developed my own wheels down confirmation check for finals that was also forgotten. Well like most incidents there are lots of reasons.

In the 3½ hours of flying, how much did I drink? Not a lot – it was honestly an enormously busy day in the cockpit, surviving and staying airborne was a challenge, and I plain forgot. The same with food – I had some food but in the workload, had had nothing in the last hour before landing.

The day was blue. We were working down low all day with no shade and very hot conditions. We were constantly with about 20+ gliders and the gaggle load was high as well all day.

At the second last thermal of the flight, I stopped flying my glider and stopped making my own decisions. In the marginal run into Benalla, the heart rate was up and the last 20 minutes or so was extremely pressured. My flight focus had become very narrow and my situational awareness had dropped. There were both physiological and psychological reasons why my flying and decision making dropped off.

The following day, a few very experienced pilots gave me a few tips for such conditions and for all flights generally:

Take a drink and food on the last climb before final glide

Fly with your left hand for a while to get the brain stimulated

Take a big stretch, move about and get the blood flowing  
Mentally and deliberately prepare for the final glide and landing  
Recognise that when you are under pressure, you will tend to get tunnel vision, so consciously relax.

Of interest, the following comes from a presentation on Human Factors and it describes how our bodies react when under pressure and the heart rate goes up:  
At 115 and 145 beats/minute heart rate, you are at the optimal state of "arousal"

After 145 bpm, bad things begin to happen - motor skills start to break down, tunnel vision sets in, you may become aggressive.

At 175 bpm there is a breakdown of cognitive processing - the fore brain shuts down (judgment goes), the mid brain takes over (unconscious reactions) and vision becomes more restricted.

Over 175 bpm, physiological control for non-essential functions shuts down - Blood is concentrated in the core muscles, you become clumsy and helpless, and some motor reactions freeze.

Anyway, I write this for anyone who may choose to use the information. Yes it was a wheels-up landing, but there are plenty of lessons to learn apart from just forgetting the FUST check.

### *POST SCRIPT*

Jeremy was standing on the side of the runway with a hand-held radio and saw the wheel was up, but elected to not give a radio call. There have been a number of

accidents where a "wheel" call was made to the pilot close to the ground that resulted in more serious damage when the pilot tried to drop the wheel on late finals.

### **CFI's report**

Now that summer is officially over the summer weather has finally arrived. The month of March has brought some great weather, some long flights and some early starts. It's good to see so much activity and let's hope the good weather continues.

Some recent achievements are:

- Paul Clark – Grob and Jeans conversions
- Ross Lovett – first solo
- Andrew Klos – Hornet conversion and passenger rating
- Ian Lesch – Hornet conversion
- Shane Roberts – A certificate and In-command rating
- Phil Szabo – Hornet conversion

Last month I advised of the appointment of the coordinators for each of the 4 stages of the training and development model. I have been really impressed with the effort and energy these members are putting into their new roles and I'm sure many members are seeing the benefits. Just as a reminder the coordinators are Denis, Richard, Pearce, Chad, Jo and Mike.

We are continually looking at ways to improve our operations and safety. In this regard the morning briefings are very important and have become a key part of our club culture.

We expect that all members who intend to fly on any given day will attend the

morning briefing. If you cant make it to briefing please talk to the duty instructor or someone who was at briefing to make sure you are fully aware of what is going on.

Ralph



Paul Bart looks on as a Harvard drops in!



A couple of likely lads...

Glider pilots are a very amicable bunch in the main. They usually go out of their way to assist people, be it retrieves, picking up parachutes, essential supplies etc etc.

During the recent Xmas break I was treated to some of this glider pilot friendship during a road trip "Down

South". First port of call was Narromine where everyone was friendly and enjoying the soaring conditions and since I was there Sans Glider I was invited to borrow the Club's Astir and take it for a lash with a Queensland Pilot that was hiding down that way... good onya Pez.

Travelling even further South and about to head North there were problems with the roads around Mt Isa so a quick look see at Mildura was in order, fancy that a gliding club! Due to pre arranged tours a quick visit was in order and with time restricted at the club to approx 90mins a flight seemed out of the question. But local Sunraysia CFI Keith Hill forced me into his Pipistral for a look at the area from a height, very different and enjoyable.

Temora was en-route and of course they glide there as well, arriving when the Bathurst and Canberra Gliding Clubs were enjoying a few weeks of cross country flying. I was tempted by a Puchacz sitting dormant but some interclub arrangements meant it went to a bona fide pilot who had taken the week off for flying so I released my frivolous claim to being there first ☺.

It is always nice to assist pilots who visit our club from elsewhere, what goes around comes around.

Keith.

## Basics of Sailplane Weight and Balance Theory

### Introduction

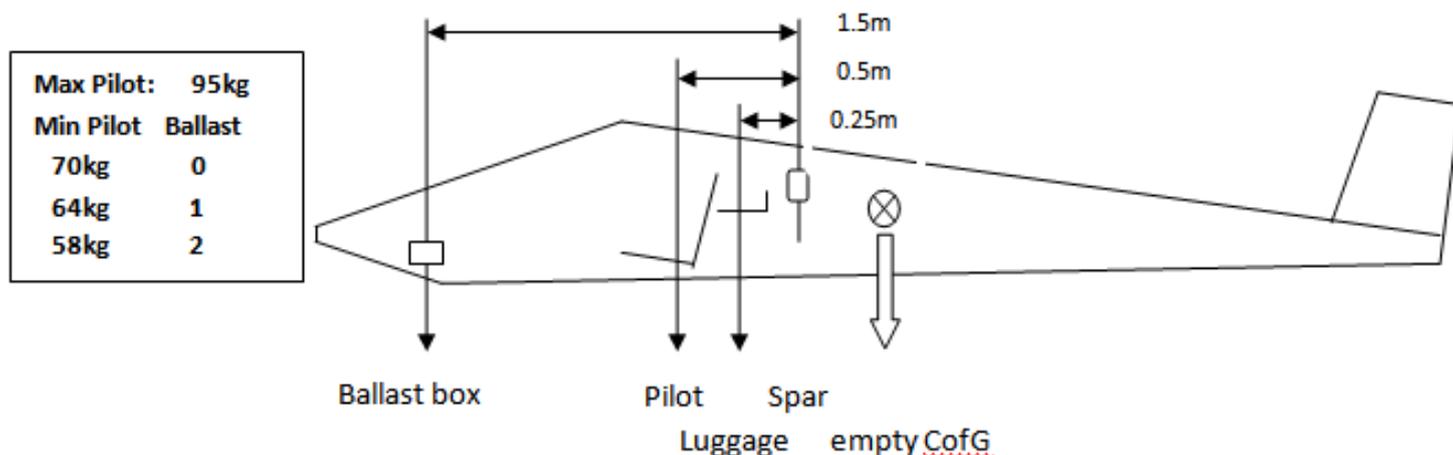
The booklet "Basic Gliding Knowledge" has a small section on "Weight and Balance". Unfortunately this does not sufficiently cover either topic in enough detail to avoid pilots making serious mistakes. This document adds sufficient information to give new pilots a better appreciation of weight and balance issues, thereby elevating their safety awareness, but does not pretend to be sufficiently rigorous to allow pilots to do their own aircraft weighing and placard creation, for which a special endorsement is required.

The structural strength of an aircraft clearly places upper limits on the weights it can support. The wings are self supporting but the fuselage and its attachments (tailplane, pilot, luggage etc) are suspended from the wings or spar. The designer of the aircraft has placed an upper limit on the weight in the fuselage (or non-lifting parts) which must never be exceeded. However other more critical issues arise when it is realized that the aircraft may not even fly if it is too "nose heavy" or too "tail heavy". In other words, if the centre of the mass (centre of gravity (C of G)) is too far forward or too far aft.

The fuselage is like a see-saw supported by the wing spar. To balance it, the centre of gravity must be very close to the spar and the designers of the sailplane type have calculated the allowable C of G variation for safe flight. This is typically only +/-70mm maximum. The consequences of too little weight at the front, resulting in a centre of gravity aft of the aft limit, are that the aircraft may pitch up, be unstable, even uncontrollable, impossible to trim, and impossible to recover from a stall/spin. Too much weight in the cockpit will result in a forward out-of-range C of G, making the pilot use full back stick/elevator (beyond trim range) to maintain speed, leaving no capacity to flare on roundout.

To determine a distribution for loading a cockpit, a pilot requires some knowledge beyond the very basic information on the placards. For example a 3kg tie-down kit or battery fastened to the spar will not upset the aircraft balance, whereas a tie-down kit stowed in the tail or nose would substantially upset the balance. Overweight pilots cannot fly, but underweight pilots have the option of appropriately ballasting the aircraft.

### Basic Single Seater



The basic placard will give a minimum (and maximum) pilot weight. The empty glider will have a C of G well behind the spar (and outside the aft limit of C of G). The pilot weight MUST have enough effect to counterbalance this empty weight. A good placard should tell the pilot how many standard ballast weights need to be added to an integrated ballast box for various pilot weights (including chute). However the educated pilot should understand a little more to safely address unusual circumstances (e.g. missing standard weights, broken box, adding luggage etc.).

Placing a weight in the aircraft cockpit creates a tipping "moment" (or torque) around the spar. The magnitude of this moment is measured by multiplying the weight by the distance ("moment arm") ahead of the spar. For example a 2kg weight in the ballast box which is 1.5m ahead of the spar produces a moment of 3kgm ( $2 \times 1.5$ ) (i.e. "three kilogram metres"). Placing a 6kg weight on the seat pan under the pilot (which is 0.5m (say) ahead of the spar also produces a moment of 3kgm ( $6 \times 0.5$ ). We see that a single correctly placed 2kg weight can compensate for a pilot who is 6kg underweight. However an inexperienced pilot does not need to do these calculations as the placard designer has done them for him. e.g. min. pilot weight 70 kg, 64kg pilot uses one standard ballast weight (of 2kg), while a 58kg pilot needs two standard weights (4kg) etc. Each glider type will have different moment arms and hence different loading placards.

If the ballast weights are placed in the seat with the same moment arm as the pilot, then 1kg ballast will offset only 1kg pilot shortfall and no calculation is needed, but one needs to weigh any unmarked ballast. Be careful to VERY adequately secure (tie in) weights as they may otherwise move under "g" forces.

It is clear that to add "luggage" a pilot should be conscious of the weight, position (moment arm) and effect on pilot weight limits. For example in this hypothetical glider above, if a pilot of 90kg (say) wanted to carry a tie-down kit (3kg) in spare space in the ballast box giving a moment of 4.5kgm ( $3 \times 1.5$ ), he would have to realise this would reduce the maximum allowed pilot weight by 9kg (i.e.  $4.5 \text{kgm} / 0.5 \text{m}$ ). The placarded max allowed pilot weight would have to be over 99kg (plus chute) for him to safely fly. Such an addition could not be permanent without reducing the placard to max 86kg ( $95 - 9$ )!

Consider a spare battery (2.5kg), tiedown kit (3kg), three litre water bottle (3kg), torch etc. (1.5kg) for a total of 10kg in a luggage compartment 0.25m in front of the spar, this would create a moment of 2.5kgm ( $10 \times 0.25$ ) which is equivalent to reduction in max allowable pilot weight at 0.5m of 5kg (because  $5 \times 0.5 = 10 \times 0.25$ ). However in this case the total weight of the non-lifting parts could be exceeded unless the pilot weight was the full 10kg below the placarded max. pilot weight. Our 90kg pilot still can't fly.

No weight should ever be placed aft of the luggage compartment without redoing the placard in case the weights are forgotten. Undocumented weight changes will throw out all placard values and place other pilots at significant risk. A glider which is slightly out of balance is sometimes said to be “out of trim” because the elevator is used in flight (normally sub-consciously) for small balance corrections, which in turn require small trim lever changes. Using elevator to offset small trim (balance) errors causes more drag and slightly reduced performance.

### Basic Two-Seater

The basic placard will give a minimum (and maximum) pilot weight. However with two seats independently loaded, the balance considerations become more complex. We have two primary loading points (seats) with different moment arms. The total moment is the sum of each individual moment. The heavier the rear pilot, the lighter can be the front pilot, but NOT kg for kg! Placards are likely to be more complicated to read than the basic single-seater. If there is ANY uncertainty about the placard limits consult an expert before flight! As with a single-seater, adding secure (smaller) ballast weights in front of the pilot can work well, but the moment arm difference for the front seat and ballast box is not as pronounced as in a single seater. Generally no separate box is available for the rear seat. Rely on the placard for correct pilot ballasting, or ask for help.

Luggage placement has the same effect as a single-seater and can affect legal pilot weights. Usually a conservative estimate of effect is adequate. For example a water bottle immediately behind the pilot adds to his effective weight kg for kg. If inexperienced, load the aircraft conservatively so as not to introduce difficult to analyse configurations.

From consideration of moment arms it is clear a ballast weight in the back seat cannot effectively compensate for a shortfall in the front seat of the same amount. Typically one needs 30-40kg in the back seat to have the same moment as 10kg in the front seat. Lead ballast weights should always be placed level with, or in front of, the front pilot. Weights MUST be very secure and generally need an engineering design unless on the front seat itself (equal moment arm to pilot).

### Aircraft Modifications

As we have shown, adding weight introduces the need for weight and balance knowledge.

When an aircraft is weighed the contents are recorded, as is the structure (e.g. wing tip extensions). Some items are also potentially removable or addable (e.g. batteries, oxygen bottles, instruments etc.). The placards are for a standard configuration which normally includes batteries and semi-permanent additions (e.g. “permanent” tie-down kit). If you want to fly without some standard item then you MUST consider the effect on weight and balance. A tie-down kit on the spar can be temporarily removed safely but one placed far from the spar cannot be left out without expert advice, and must of course be replaced after flight. A forward mounted battery cannot be discarded. It follows that if you make a permanent change to the weight and balance of an aircraft you are invalidating the placard. Such changes should only be made by authorized persons and must be recorded in the log book along with calculations for a new placard. Changes are not uncommon over the years. For example a repair may add weight to the tail boom dictating a new weighing. Fitting a second (backup) battery or “heavy” instrumentation must be documented correctly, and removal of an oxy-bottle (say) must be likewise documented.

### Water Ballast

More advanced gliders carry additional weight in the load bearing parts (wings). This water ballast can enhance performance but also affects the weight and balance of the glider. Water ballast is generally quite close to the spar (0.15m say), but can still introduce a forward movement of C of G. requiring back trim. Some gliders are fitted with an auxiliary tank in the tail to permit a counter balance. The safe limits for water should be in the flight manual. Note that for every kg in the tail tank, the max pilot weight must be reduced by 1kg so as to not exceed the maximum all up weight of the non-lifting parts.

A maximum all-up weight for the glider might be exceeded for a max weight pilot with full ballast tanks. Pilots should study all available charts and limits before using near maximum ballast. Wing tip extensions can result in extra stresses from water ballast such that a 16.6m glider cannot carry as much water as the same aircraft with 15m wingspan. (e.g. Ventus GGH) No pilot should fill the tanks and take off without checking the limits first. Theoretically the max pilot weight may also be affected by the amount of water ballast added because of trim (balance) changes. (e.g. with full tail tank, the max. pilot + luggage + chute in VH-GGH is 84kg (& min. 79kg!))

Tail tank water should rarely be full. Charts based on mathematical balance analysis should be available for various configurations of pilot and wing water ballast weights. Be careful not to leave any water in the tanks after flight. Particularly ensure tail tanks are drained as a light pilot flying with a full tail tank and no main tank water, due to a stuck valve for example, would be highly undesirable. Pay attention to the tanks when doing a Daily Inspection. E.g., to be safe, open valves and remove the tape from the bottom hole in the Ventus (GGH) tail tank.

| Day      | Instructors                               | Tug Pilots                      | Duty Pilots       |
|----------|---|---------------------------------|-------------------|
| Sat 4th  | Women in Gliding Week                     | TBA                             | Bob Flood         |
| Sun 5th  | Women in Gliding Week                     | TBA                             | Graham Hennessy   |
| Fri 10th |   | Pam Kurstjens                   |                   |
| Sat 11th | Jenny Thompson (L2)                       | Charlie Moses                   | Leonid Motin      |
| Sun 12th | Jeremy Thompson (L2/Coach)                | Gerrit Kurstjens                | Bill Smith        |
| Sat 18th | Volunteer Needed                          | Andrew Straume<br>Scott Merrick | Anton Grisin      |
| Sun 19th | Andrew Huggins (L3)                       | Fran Ning                       | Richard Armstrong |
| Sat 25th | Peter Bell (L3/Coach)<br>Keith Allen (AE) | Lex McQueen                     | Roly Sundell      |
| Sun 26th | Charlie Downes (L2)<br>Barry Daniel (L1)  | Des Baartz                      | Paul Bart         |